

STATE OF COLORADO  
DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

RADIOACTIVE MATERIALS LICENSE

Pursuant to the Radiation Control Act Title 25, Article 11, CRS 1989, Replacement Volume, as amended, and the State of Colorado Rules and Regulations Pertaining to Radiation Control, Part 3, and in reliance on statements and representations heretofore made by the licensee designated below; a license is hereby issued authorizing such licensee to transfer, receive, possess and use the radioactive material(s) designated below; and to use such radioactive material(s) for the purpose(s) and at the place(s) designated below. This license is subject to all applicable rules, regulations, and orders now or hereafter in effect of the Colorado Department of Public Health and Environment and to any conditions specified below.

Licensee	
1. Name: Colorado School of Mines	3. In accordance with the letter dated December 22, 1998, License No. Colo. 627-01 is amended in its entirety.
2. Address: 1500 Illinois Street Golden, CO 80401	4. Expiration date: September 30, 2002
	5. Reference number:

6. Radioactive materials (element and mass no.)	7. Chemical and/or physical form	8. Maximum quantity licensee may possess at any one time
A. Cobalt 60	A. Sealed source (Tracer Lab model R-30)	A. 1 source not to exceed 370 MBq (10 mCi)
B. Cesium 137	B. Sealed source	B. 1 source not to exceed 185 MBq (5 mCi)
C. Americium 241	C. Plated source	C. 1 source not to exceed 4.44 kBq (0.12 µCi)
D. Plutonium 239:Be and Plutonium 241:Be	D. Sealed source (NUMEC model B [Pu-Be])	D. 1 source not to exceed 74 GBq (2 Ci)
E. Cobalt 56	E. Sealed source (Isotope Products model GF-056D)	E. 37 kBq (1 µCi)
F. Curium 244	F. Sealed source (Isotope Products model AFR-244-3M)	F. 2 sources, not to exceed 148 MBq (4 mCi) total

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6. Radioactive materials (element and mass no.)	7. Chemical and/or physical form	8. Maximum quantity licensee may possess at any one time
G. Curium 244	G. Sealed source (Amersham CLNK 3863)	G. 5.92 GBq (160 mCi)
H. Tin 119m	H. Any	H. 74 MBq (2 mCi)
I. Tin 119m	I. Sealed source (Amersham model TXDK)	I. 4 sources, no single source to exceed 370 MBq (10 mCi)
J. Samarium 151	J. Sealed source (New England Nuclear)	J. 1 source not to exceed 925 MBq (25 mCi)
K. Tin 121m	K. Sealed source (NEN model NER-093)	K. 1 source not to exceed 7.4 MBq (0.2 mCi)
L. Antimony 125	L. Sealed source (NEN model NER-098)	L. 1 source not to exceed 259 MBq (7 mCi)
M. Cobalt 57	M. Sealed source (NEN model NER-072A or Amersham model CTD.D2)	M. 8 sources, no single source to exceed 925 MBq (25 mCi). Total possession not to exceed 3.70 GBq (100 mCi).
N. Hydrogen 3	N. Any	N. 185 MBq (5 mCi)
O. Carbon 14	O. Any	O. 185 MBq (5 mCi)
P. Uranium 232	P. Any	P. 37 MBq (1 mCi)
Q. Uranium 233	Q. Any	Q. 185 MBq (5 mCi)
R. Uranium 234	R. Any	R. 370 MBq (10 mCi)
S. Uranium 235	S. Any	S. 370 kBq (10 $\mu$ Ci)

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T. Americium 241	T. Any	T. 370 kBq (10 $\mu$ Ci)
U. Americium 241	U. Soil and sediment	U. 55.5 Bq (0.0015 $\mu$ Ci)
V. Antimony 125	V. Any	V. 370 kBq (10 $\mu$ Ci)
W. Cadmium 109	W. Any	W. 370 kBq (10 $\mu$ Ci)
X. Cerium 139	X. Any	X. 370 kBq (10 $\mu$ Ci)
Y. Cesium 134	Y. Any	Y. 370 kBq (10 $\mu$ Ci)
Z. Cesium 137	Z. Any	Z. 370 kBq (10 $\mu$ Ci)
AA. Cobalt 57	AA. Any	AA. 370 kBq (10 $\mu$ Ci)
BB. Cobalt 60	BB. Any	BB. 370 kBq (10 $\mu$ Ci)
CC. Curium 244	CC. Any	CC. 370 kBq (10 $\mu$ Ci)
DD. Europium 152	DD. Any	DD. 370 kBq (10 $\mu$ Ci)
EE. Europium 154	EE. Any	EE. 370 kBq (10 $\mu$ Ci)
FF. Europium 155	FF. Any	FF. 370 kBq (10 $\mu$ Ci)
GG. Mercury 203	GG. Any	GG. 370 kBq (10 $\mu$ Ci)
HH. Radium 226	HH. Any	HH. 370 kBq (10 $\mu$ Ci)
II. Radium 228	II. Any	II. 370 kBq (10 $\mu$ Ci)
JJ. Sodium 22	JJ. Any	JJ. 185 MBq (5 mCi)
KK. Strontium 85	KK. Any	KK. 370 kBq (10 $\mu$ Ci)
LL. Sulfur 35	LL. Any	LL. 18.5 MBq (500 $\mu$ Ci)

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MM. Tin 113	MM. Any	MM. 370 MBq (10 mCi)
NN. Yttrium 88	NN. Any	NN. 370 MBq (10 mCi)
OO. Plutonium 239, 240 and 241	OO. Soil and sediment	OO. 555 MBq (15 mCi)
PP. Plutonium 242	PP. Solution	PP. 74 Bq (2 nCi)
QQ. Thorium 234	QQ. Thorium nitrate	QQ. 37 MBq (1 mCi)
RR. Radium 226	RR. Sealed source	RR. 1 source, not to exceed 40.7 MBq (1.1 mCi)
SS. Radium 226	SS. Dry stearate salt	SS. 6 sources, not to exceed 77.7 MBq (2.1 mCi) total
TT. Thorium 230	TT. Sealed source (Eberline)	TT. 26 sources, not to exceed 37 kBq (1 $\mu$ Ci) total
UU. Krypton 85	UU. Gas in sealed tube	UU. 5 sources, not to exceed 463 MBq (12.5 mCi) total
VV. Plutonium 238	VV. Sealed source	VV. 1 source, not to exceed 370 Bq (10 nCi)
WW. Americium 241	WW. Foil Source (Amersham AMM1001H)	WW. 1 source, not to exceed 3.70 MBq (100 $\mu$ Ci)
XX. Americium 241	XX. Sealed source (Gammatron)	XX. 2 sources, no single source to exceed 9.25 GBq (250 mCi)
YY. Thorium oxide	YY. Crucibles	YY. 10 crucibles, not to exceed 650 grams total weight
ZZ. Cesium 137	ZZ. Sealed source (Troxler Dwg. A-102112)	ZZ. 1 source, not to exceed 333 MBq (9 mCi)

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AAA. Americium 241:Be	AAA. Sealed source (Troxler Dwg. A-102451)	AAA. 1 source, not to exceed 1.63 GBq (44 mCi)
BBB. Cesium 137 and Americium 241:Be	BBB. Sealed source (CPN-131)	BBB. 1 source, not to exceed 370 MBq (10 mCi) of Cs 137 and 1.85 GBq (50 mCi) of Am 241
CCC. Hydrogen 3	CCC. Foil (U.S. Radium Corp.)	CCC. 1 source, not to exceed 6.37 GBq (0.172 Ci).
DDD. Hydrogen 3	DDD. Foil (U.S. Radium Corp.)	DDD. 1 source, not to exceed 191 GBq (5.16 Ci)
EEE. Radium 226	EEE. Any form	EEE. As necessary for use authorized in Condition
FFF. Thorium 230	FFF. Sealed source	FFF. 2.49 kBq (67.3 nCi)
GGG. Plutonium 238	GGG. Sealed source	GGG. 315 Bq (8.51 nCi)
HHH. Hydrogen 3	HHH. Tritiated water	HHH. 3.70 MBq (100 $\mu$ Ci)
III. Mixed Gamma Standard: Cadmium 109, Cobalt 57, Cobalt 60, Cerium 139, Mercury 203, Tin 113, Cerium 137, Strontium 89, Yttrium 88	III. Acid solution	III. 370 kBq (10 $\mu$ Ci)
* JJJ. Thorium 230	JJJ. Acid solution	JJJ. 370 kBq (10 $\mu$ Ci)
KKK. Americium 241	KKK. Acid solution	KKK. 370 kBq (10 $\mu$ Ci)
* LLL. Cobalt 60	LLL. Acid solution	LLL. 370 kBq (10 $\mu$ Ci)

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* MMM. Strontium 89	MMM. Acid solution	MMM. 370 kBq (10 $\mu$ Ci)
* NNN. Strontium 90	NNN. Acid solution	NNN. 370 kBq (10 $\mu$ Ci)
* OOO. Cesium 137	OOO. Acid solution	OOO. 370 kBq (10 $\mu$ Ci)
* PPP. Cesium 134	PPP. Acid solution	PPP. 370 kBq (10 $\mu$ Ci)
* QQQ. Uranium natural	QQQ. Acid solution	QQQ. 370 kBq (10 $\mu$ Ci)
* RRR. Radium 226	RRR. Acid solution	RRR. 370 kBq (10 $\mu$ Ci)
* SSS. Radium 228	SSS. Acid solution	SSS. 370 kBq (10 $\mu$ Ci)
TTT. Americium 243	TTT. Acid solution	TTT. 370 kBq (10 $\mu$ Ci)
UUU. Plutonium 242	UUU. Acid solution	UUU. 370 kBq (10 $\mu$ Ci)
VVV. Carbon 14	VVV. Liquid	VVV. 37 MBq (1 mCi)
* WWW. Hydrogen 3	WWW. Liquid	WWW. 3.7 GBq (100 mCi)
XXX. Plutonium 239	XXX. Acid solution	XXX. 37 kBq (1 $\mu$ Ci)
YYY. Uranium (Depleted)	YYY. Metal	YYY. 1.885 kilograms
ZZZ. Americium 241	ZZZ. Sealed source (Amersham model AMC.P5)	ZZZ. 1 source not to exceed 7.4 GBq (200 mCi)
AAAA. Cesium 137	AAAA. Sealed source (Amersham model CDC.809)	AAAA. 1 source not to exceed 3.7 GBq (100 mCi)
BBBB. Chromium 51	BBBB. Acid solution	BBBB. 37 MBq (1 mCi)
CCCC. Nickel 63	CCCC. Acid solution	CCCC. 37 MBq (1 mCi)
* DDDD. Zinc 65	DDDD. Acid solution	DDDD. 37 MBq (1 mCi)

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EEEE. Cadmium 109	EEEE. Acid solution	EEEE. 37 MBq (1 mCi)
FFFF. Mercury 203	FFFF. Acid solution	FFFF. 37 MBq (1 mCi)
* GGGG. Zinc 65	GGGG. Acid solution	GGGG. 370 kBq (10 $\mu$ Ci)
* HHHH. Barium 133	HHHH. Acid solution	HHHH. 370 kBq (10 $\mu$ Ci)
IIII. Iodine 131	IIII. Aqueous solution	IIII. 370 kBq (10 $\mu$ Ci)
JJJJ. Plutonium 239	JJJJ. Acid solution	JJJJ. 370 kBq (10 $\mu$ Ci)

CONDITIONS

- 9.A. Radioactive material authorized in Items 6.A. through 6.G. to be used for calibration and student experiments.
- B. Radioactive materials authorized in Items 6.H. through 6.M. to be used for Mossbauer Spectroscopy.
- C. Radioactive materials authorized in Items 6.N. through 6.T., 6.V. through 6.NN., 6.PP, 6.QQ. and 6.JJJJ. to be used as laboratory tracers in physical and chemical processes.
- D. Radioactive materials authorized in Items 6.U. and 6.OO. to be used for quantitative and qualitative analysis of environmental samples.
- E. Radioactive materials authorized in Items 6.RR. and 6.SS. are to be used in calibration of radiation measuring devices and generation of radon.
- F. Radioactive materials authorized in Items 6.TT. and 6.VV. are to be used in calibration of measuring devices.
- G. Radioactive material authorized in Item 6.UU. to be used to remove ions from gas streams in analytical devices.
- H. Radioactive material authorized in Item 6.WW. to be used to produce alpha particles in research and development.

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- 9.I. Radioactive material authorized in Item 6.XX. to be STORED ONLY until lawful disposal can be completed.
- J. Radioactive material authorized in Item 6.YY., 6.CCC., and 6.DDD. to be STORED ONLY.
- K. Radioactive materials authorized in Items 6.ZZ. and 6.AAA. to be STORED ONLY in a Troxler 3411B model moisture/density gauge.
- L. Radioactive materials authorized in Item 6.BBB. to be STORED ONLY in a CPN B(R) surface moisture/density gauge.
- M. Radioactive materials authorized in Items 6.EEE. to be STORED ONLY as contaminated building materials in the Engineering Hall and appurtenances, and in soils in contiguous areas, except those which meet the current guidelines for decontamination of equipment and facilities for unrestricted use.
- N. Radioactive materials authorized in Items 6.FFF. and 6.GGG. to be used for calibration and reference.
- O. Radioactive materials authorized in Items 6.HHH. through 6.UUU. and 6.GGGG. through 6.IIII. to be used for radiochemical reference standards.
- P. Radioactive materials authorized in Items 6.VVV. and 6.WWW. to be used as tracers to measure membrane diffusion rates.
- Q. Radioactive material authorized in Item 6.XXX. to be used in experiments to determine the sorption rates of Pu on colloidal particles in aqueous solutions of varying pH.
- R. Radioactive material authorized in Item 6.YYY. to be STORED ONLY.
- S. Radioactive materials authorized in Items 6.ZZZ. and 6.AAAA. to be used for research and development.
- T. Radioactive materials authorized in Items 6.BBBB. through 6.FFFF. to be used for research in diffusion rates of metals from sediments.
- 10.A. Radioactive materials authorized in Item 6.A. through 6.G. shall be stored in the Hazardous Materials Management Facility and used in Suite 147 and Laboratory 149 in Meyer Hall, Colorado School of Mines, Golden, Colorado.



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- 10.B. Radioactive materials authorized in Item 6.H. through 6.M and 6.WW. shall be stored in the Hazardous Materials Management Facility and used in Laboratory 257 in Meyer Hall, Colorado School of Mines, Golden, Colorado.
- C. Radioactive materials authorized in Item 6.N. through 6.QQ. and 6.JJJJ. shall be stored in the Hazardous Materials Management Facility and used in Laboratories 236/242 in Coolbaugh Hall, Colorado School of Mines, Golden, Colorado.
- D. Radioactive materials authorized in Item 6.RR. through 6.VV., 6.FFF., and 6.GGG. shall be stored in the Hazardous Materials Management Facility and used in Laboratory 132 in Coolbaugh Hall, Colorado School of Mines, Golden, Colorado.
- E. Radioactive materials authorized in Items 6.XX. through 6.EEE., and 6.YYY. shall be STORED ONLY at Colorado School of Mines, Golden, Colorado.
- F. Radioactive materials authorized in Items 6.HHH. through 6.SSS., and 6.XXX. through 6.IIII shall be stored and used in Laboratory 235 in Coolbaugh Hall, Colorado School of Mines, Golden, Colorado.
- G. Radioactive materials authorized in Items 6.TTT. and 6.UUU. shall be stored and used in Laboratory 236 in Coolbaugh Hall, Colorado School of Mines, Golden, Colorado.
- H. Radioactive materials authorized in Item 6.VVV. and 6.WWW. shall be stored and used in Laboratory 486 in Alderson Hall and used and disposed of in Laboratory 236 in Coolbaugh Hall, Colorado School of Mines, Golden, Colorado.
- I. Radioactive materials authorized in Items 6.ZZZ. and 6.AAAA. shall be stored and used in the Materials Science Building, Colorado School of Mines, Golden, Colorado.
- J. Radioactive materials authorized in Items 6.BBBB. through 6.FFFF. shall be stored and prepared in Laboratory 236, and used in Laboratory 235 in Coolbaugh Hall, Colorado School of Mines, Golden, Colorado.
11. The licensee shall comply with the provisions of the State of Colorado *Rules and Regulations Pertaining to Radiation Control*, Part 4, "Standards for Protection Against Radiation" and Part 10, "Notices, Instructions and Reports to Workers: Inspections".
- 12.A. Radioactive materials authorized in Items 6.A. through 6.G. shall be used by, or under the supervision of F. E. Cecil.

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- 12.B. Radioactive materials authorized in Items 6.H. through 6.M. shall be used by, or under the supervision of D. L. Williamson.
- C. Radioactive materials authorized in Items 6.N. through 6.QQ.; 6.SSS. through 6.UUU.; 6.XXX.; and 6.BBBB. through 6.JJJJ. shall be used by, or under the supervision of B.D. Honeyman.
- D. Radioactive materials authorized in Items 6.RR. through 6.VV., 6.FFF. and 6.GGG. shall be used by, or under the supervision of Robert Holub.
- E. Radioactive material authorized in Item 6.WW. shall be used by, or under the supervision of James McNeil.
- F. Radioactive materials authorized in Items 6.XX. through 6.EEE., and 6.YYY. shall be STORED ONLY under the supervision of R. A. MacPherson.
- G. Radioactive materials authorized in Items 6.VVV. and 6.WWW. shall be used by, or under the supervision of Annette Bunge.
- H. Radioactive materials authorized in Items 6.ZZZ. and 6.AAAA. shall be used by, or under the supervision of Tissa Illangasekare.
13. The designated Radiation Safety Officer is Robert A. MacPherson.
14. Radioactive material authorized by Item 6 of this license shall be stored and used in a manner which will preclude use by unauthorized personnel.
- 15.A. Each sealed source authorized in Item 6 of this license, except as noted below, shall be tested for leakage in accordance with the requirements of RH 4.16 of the *State of Colorado Rules and Regulations Pertaining to Radiation Control*, at intervals not to exceed six months.
- B. Sealed sources authorized in Items 6.ZZZ. and 6.AAAA. shall be leak tested upon receipt, removal from use, and when the shielded enclosure is opened. Leak test frequency shall not exceed three (3) years.
16. Sealed sources containing radioactive material shall not be opened or removed from their respective source holders by the licensee.
17. Radiation detection and counting equipment shall be calibrated annually by persons approved by the U.S. Nuclear Regulatory Commission or an Agreement State.

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18. Each source holder and logging tool containing radioactive material shall bear a legible and visible marking. The marking shall bear the conventional radiation symbol and the following wording: DANGER - RADIOACTIVE - DO NOT HANDLE - NOTIFY CIVIL AUTHORITIES.
19. The licensee shall not transfer possession and/or control of materials or products containing radioactive material as a contaminant except:
  - A. by transfer of waste to an authorized recipient;
  - B. by transfer to a specifically licensed recipient; or,
  - C. as provided otherwise by specific condition of this license pursuant to the requirements of RH 3.22 of the State of Colorado Rules and Regulations Pertaining to Radiation Control.
- 20.A. The licensee may transport radioactive material or deliver radioactive material to a carrier for transport, in accordance with the provisions of RH 17.5 of the State of Colorado Rules and Regulations Pertaining to Radiation Control, "Transportation of Licensed Material".
- B. The transportation of radioactive materials within the State of Colorado shall be subject to all applicable regulations of the Colorado Public Utilities Commission, Colorado Department of Transportation, Colorado Department of Public Safety, Colorado Department of Revenue (Port of Entry), U.S. Department of Transportation, and other agencies of the United States having jurisdiction. When the U.S. Department of Transportation Regulations (Title 49, Chapter I, Code of Federal Regulations) are not applicable to shipments by land of Colorado radioactive material by reason of the fact that the transportation does not occur in interstate or foreign commerce, the licensee must be in compliance with the requirements relating to packaging of the radioactive material, marking and labeling of the package, placarding of the transport vehicle, and accident reporting set forth in the regulations of the U.S. Department of Transportation.

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21. Prior to any work, such as repairs, remodeling, or removal of building materials, which impacts the controlled areas of the Engineering Hall or surrounding grounds, an evaluation must be completed to include the following:

- A. impact on the controlled area;
- B. procedures for protection of the workers;
- C. control of spread of contamination;
- D. disposal of removed contaminated materials; and
- E. monitoring during and after work to demonstrate no spread of contamination.

Written records of the evaluation, verification of actions taken, and results of monitoring must be maintained by the licensee.

22. The State of Colorado Rules and Regulations Pertaining to Radiation Control shall govern the licensee's statements in applications or letters, unless the licensee's statements are more restrictive than the regulations. Except as specifically provided otherwise by this license, the licensee shall possess and use radioactive material described in Items 6, 7 and 8 of this license in accordance with statements, representations, and procedures contained in:

- A. the application and attachments dated August 29, 1997; and
- B. the license correspondence and attachments dated September 2, 1997; September 3, 1997; December 9, 1997; December 17, 1997; June 24, 1998; September 1, 1998; and October 6, 1998; and December 22, 1998.
- C. the Colorado School of Mines Radiation Protection Program, Revised December, 1997.

FOR THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Date January 13, 1999  
OR-RH-18

By W. J. [Signature]

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